732,436

(71)

FIG. 1.

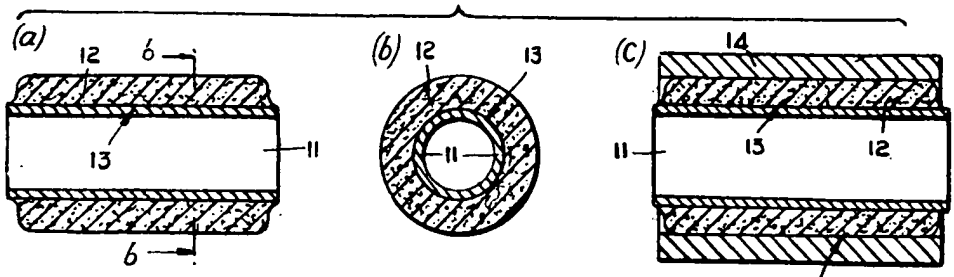


FIG. 2.

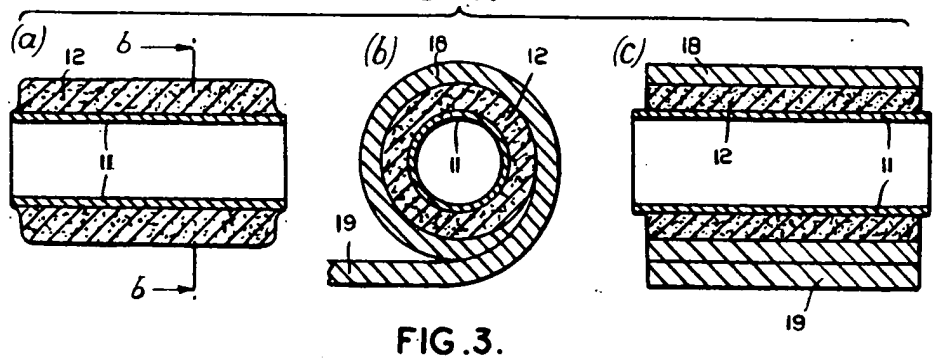


FIG. 3.

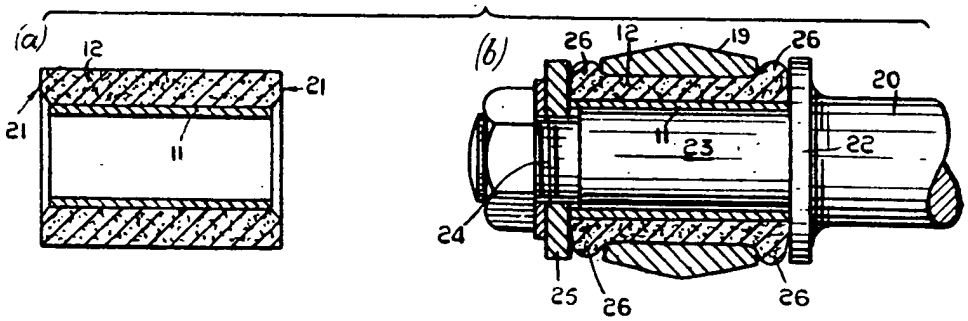
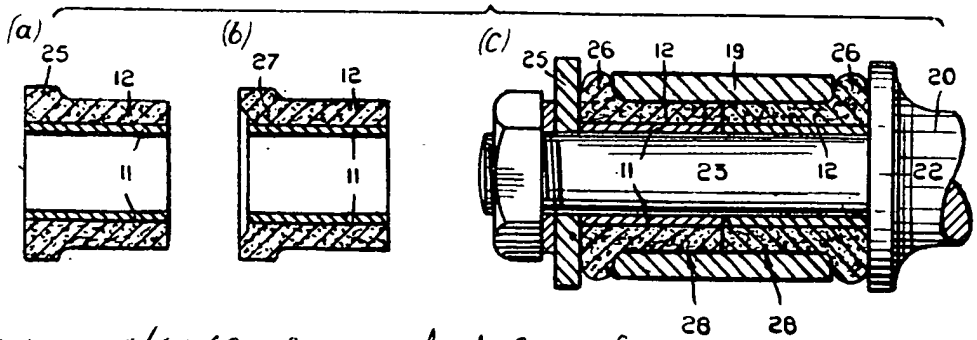


FIG. 4.



Inner sleeve expanded for frictional grip of outer surface and is bonded to rubber.

267/270

Red

732,436 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

FIG.5.

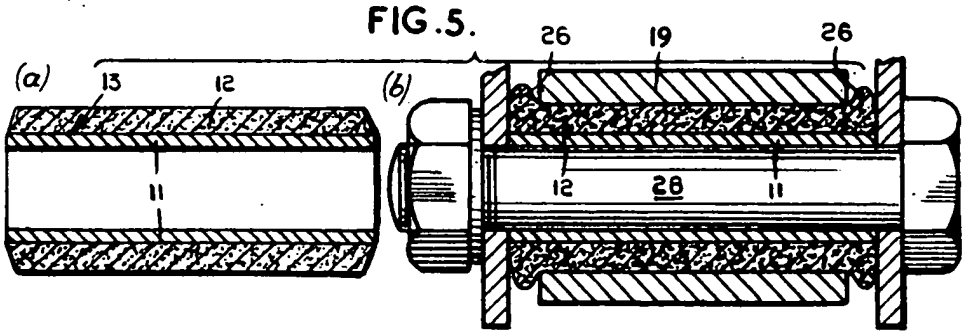


FIG.6.

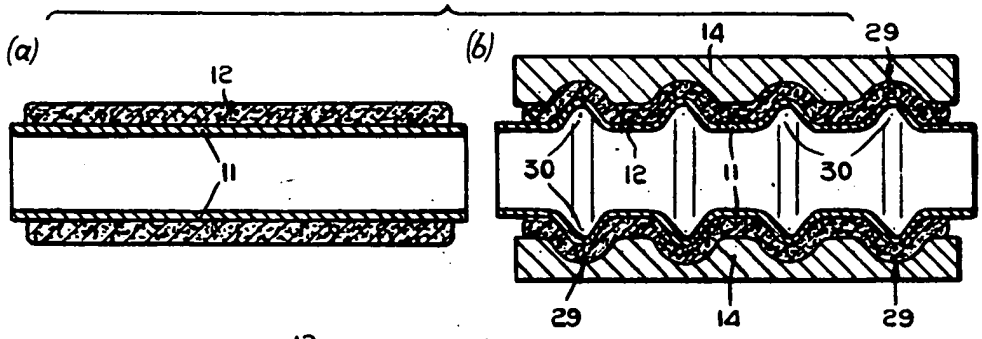
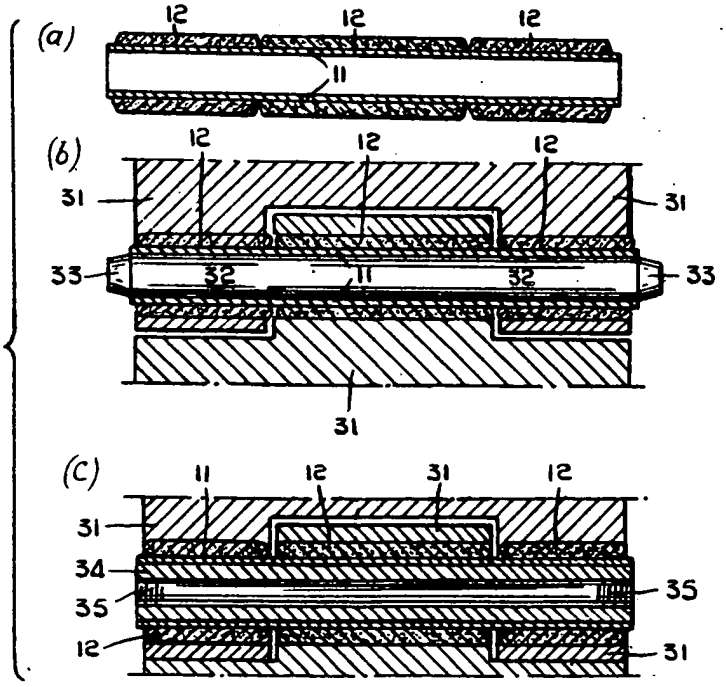


FIG.7.



732,436 COMPLETE SPECIFICATION

3 SHEETS

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SHEET 3

FIG. 8.

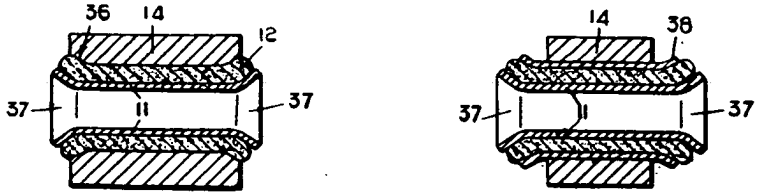
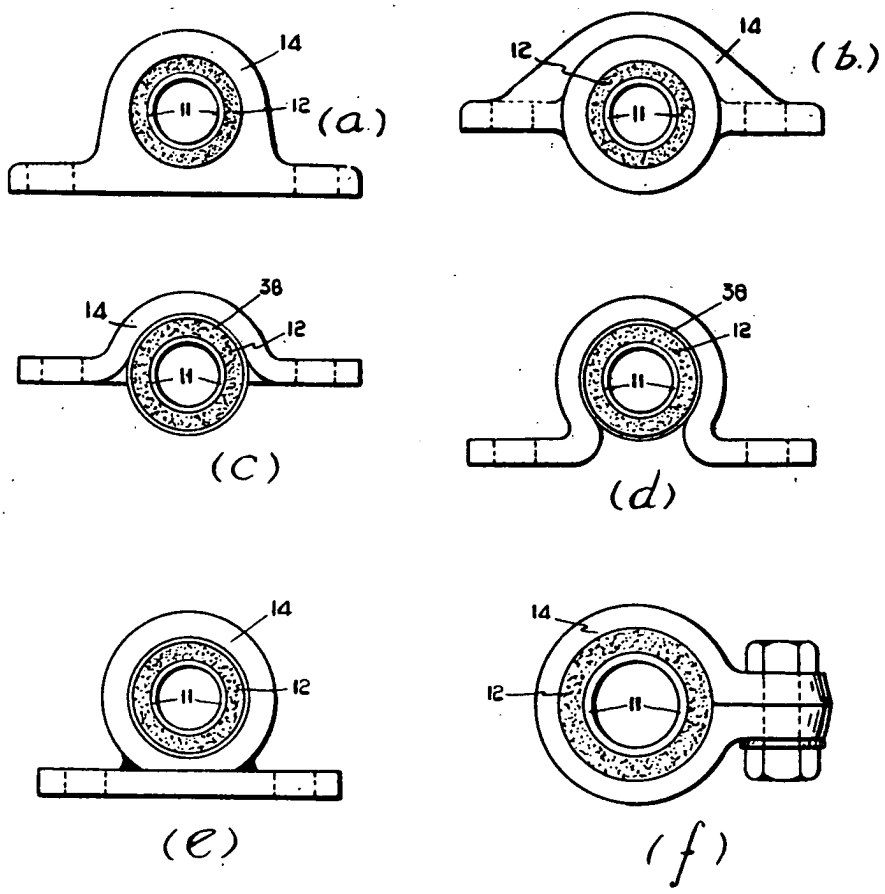


FIG. 9.



PATENT SPECIFICATION

Inventor: ALUN JOHN REED

732,436

Date of filing Complete Specification: Oct. 2, 1952.

Application Date: July 3, 1951. *No. 15731/51.*

Complete Specification Published: June 22, 1955.

Index at acceptance:—**Class 108(3)**, L1E2, R.

COMPLETE SPECIFICATION

Bonded Rubber Bushes

We, METALASTIK LIMITED, a British Company, of Evington Valley Road, Leicester, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to bonded rubber bushes comprising a metal element and a surrounding elastic material. Rubber bushes are known in which an inner tubular metal member and an outer tubular metal member are employed with the elastic material arranged as a filling in the space between them, the surfaces of the filling being secured to the opposing metal faces of the tubular metal members. In Patent Specification 581,464 a rubber filling is surface-bonded by vulcanisation to the opposing surfaces of the metal members and, after the bonding, the filling is placed under compression by the distortion of one of the metal members, in a manner causing reduction of the space between them throughout the length of the bush. The compression thus applied replaces the state of tension normally liable to be present in the rubber after vulcanisation and leaves a condition of pre-compression therein.

It is also known to employ a rubber bush around an inner metal member the bushing being forced under axial pressure into housings, as for example into the hinge eye of a vehicle spring. The forcing of the bush into place causes such adhesion of the rubber surface to the housing as to enable the rubber to function as a torsion spring between the housing and the inner metal member permitting, with resistance in torsional shear, a degree of pivotal or angular movement between the housing and the inner metal member and resisting, mainly in compression, relative radial movements between the inner metal member and the housing.

The present invention consists in a bush comprising an expansible continuous hollow cylindrical metal element and a cylindrical rubber sleeve moulded around the element and surface bonded thereto, the unbonded surface of the rubber sleeve being free.

The present invention further consists in a method of bushing with rubber metal elements adapted to be assembled one wholly or partly within the other, comprising slidably or otherwise inserting a bush as above defined into a suitable bore in an outer metal element, and outwardly expanding the expansible inner metal element to pre-compress the rubber sleeve in all radial directions and produce adherence of the outer surface of the rubber sleeve with the surface of the bore of the outer metal element.

The bushes manufactured in the manner set forth may be used for many purposes and offer certain advantages in economy and ease of manufacture, and some saving in space where they are fitted direct into an outer metal element or housing forming part of a machine or other structure. By bonding the rubber of the bush to the inner metal sleeve where the stress is greatest considerable advantage in use is obtained over an unbonded type of bush. Moreover, the outer metal element or housing adapted to receive the bonded inner metal element and rubber sleeve can be made within reasonably wide limits and in some cases without a machined or otherwise accurately finished hole so that cast bores or rolled spring eyes can be satisfactorily bushed.

The broad principle of manufacture and examples of the more probable applications of the invention are illustrated in the accompanying drawings in which:—

Figures 1 (*a*), (*b*) and (*c*) illustrate in section stages in the manufacture of a bush in which a tubular inner metal element is expanded on assembly.

Figures 2 (*a*), (*b*) and (*c*) illustrate in section stages in the manufacture of a spring eye bush.

Figures 3 (*a*), and (*b*) illustrate in section stages in the manufacture of a bush for an independent front suspension pivot.

[*Price 3s. 0d.*]

Figures 4 (*a*), (*b*) and (*c*) illustrate in section stages in the manufacture of an alternative bush for an independent front suspension pivot.

Figures 5 (*a*) and (*b*) illustrate in section stages in the manufacture of a bushed pin or bolt.

Figures 6 (*a*) and (*b*) illustrate in section stages in the manufacture of a ribbed bush.

Figures 7 (*a*), (*b*) and (*c*) illustrate in section stages in the manufacture of a bushed hinge for an endless track.

Figures 8 (*a*) and (*b*) illustrate in section alternative forms of bushes having one or more flared components.

Figures 9 (*a*), (*b*), (*c*), (*d*), (*e*) and (*f*) illustrate in elevation bushes employed in alternative forms of outer metal elements or housings.

Like references are used to indicate like parts in the following description.

In Figure 1 (*a*) a cylindrical expansible inner metal element 11 is surrounded by a rubber sleeve 12 which, conveniently, is moulded around the element 11. The length of the sleeve 12 is somewhat less than that of the element 11. The element 11 and the sleeve 12 are surface bonded together at the interface 13 leaving the unbonded faces of the sleeve 12 free. An outer metal element or housing 14, the length of which may be somewhat less than that of the inner metal element 11 is provided with a suitable hole or bore 14 to receive the bonded element 11 and sleeve 12. The hole 14 may have a diameter relatively to the external diameter of the bonded element 11 and sleeve 12 such that the latter is a force, push, sliding or a slack fit in the hole 14, although in most instances a slack fit will be preferred. Upon assembly the bonded element 11 and sleeve 12 are inserted in the hole 14 and the inner element 11 is then forcibly expanded radially with respect to its longitudinal axis with a suitable tool (not shown) so that the rubber sleeve 12 is compressed and adheres to the interface 15 between the sleeve 12 and the element or housing 14 as in Figure 1 (*c*). Conveniently, the tool may comprise a tapered mandrel.

The expansible metal element 11 is conveniently thin-walled to facilitate its expansion, and may be made of a fully annealed steel, such as mild steel, or brass.

In Figure 2 (*a*) a bonded expansible cylindrical inner metal element 11 and surrounding rubber sleeve 12 similar to that shown in Figure 1 (*a*) are provided for insertion in the eye 18 of a spring or leaf 19 (see Figure 2 (*b*)). The diameter of the eye 18 is such that the bonded element 11 and rubber sleeve 12 can be inserted therein, either slidably, or without undue pressure whereupon the cylindrical inner metal element 11 is expanded to pre-compress the rubber and cause it to adhere to the inner bearing face of the eye 18 as in Figure 2 (*c*).

In Figure 3 (*a*) a bonded expansible cylindrical inner metal element 11 and surrounding rubber sleeve 12 are shown preparatory to their being fitted over an independent front suspension pivot 20 (see Figure 3 (*b*)), and in the bore of a hinge eye, suspension arm or other member 19 of the suspension hinged to the pivot pin 20. For this purpose, the length of the rubber sleeve 12 may be less than or equal to that of the inner metal element 11, as in Figure 1 (*a*) or, as shown in Figure 3 (*a*), its ends 21 may project wholly or partly beyond the ends of the element 11. Upon assembly, the bonded element 11 and rubber sleeve 12 are inserted in the eye or other member 19, which member is conveniently of reduced axial length relatively to that of the element 11 and sleeve 12, and the element 11 is radially expanded to pre-compress the rubber and to provide adherence of the rubber to the inner surface of the member 19.

The degree of expansion of the inner metal element 11 is controlled to permit the assembled element 11, sleeve 12 and member 19 properly to seat on the pivot pin 20 which is conveniently provided with a shoulder or flange 22 adjacent one end of its bearing surface 23 and a screw-threaded portion 24 of reduced diameter adjacent the other end of the bearing surface 23. On expansion of the element 11, the ends of the rubber sleeve 12 which are not covered by the member 19 will tend to bulge and, upon clamping of the assembled element 11, sleeve 12 and member 19 between the flange 22 and a washer 25 on the reduced portion 24, the unrestrained ends of the rubber sleeve 12 will be bulged or upset between the ends of the member 19 and the flange 22 and the washer 25 respectively to provide buffers 26 frictionally engaging the confronting surfaces of the members 19, flange 22 and washer 25 respectively. If desired, the bonded inner metal element 11 and rubber sleeve 12 can be inserted in a tubular outer metal element to form a unitary bush prior to their insertion in the member 19 and over the pivot pin 20, and the inner element 11 is expanded to pre-compress the rubber before assembly of the unit in the member 19. Moreover, after assembly of the unit in the member 19 a further degree of pre-compression may be imparted to the rubber by again expanding the inner metal element. It will be seen that on assembly, the flange 22 and the washer 25 enter into abutment with the ends of the inner element 11.

Figures 4 (*a*), (*b*) and (*c*) illustrate the manufacture of a composite bush applied, as in Figure 3 (*a*) and (*b*), to an independent front suspension pivot pin 20. Each bonded cylindrical expansible inner metal element

11 and rubber sleeve 12 is formed in two identical parts as shown particularly in Figure 4 (*a*) or Figure 4 (*b*). The length of the rubber sleeve 12 is less than or, as shown in Figure 5 (*a*), equal to the length of the inner element 11. During the moulding or other formation of the sleeve 12 an outwardly directed flange or lip 27 is provided at one end of the sleeve 12. Alternatively, as in Figure 4 (*b*), one end of the rubber sleeve 12 overhangs the inner metal element 11 and it is at this overhanging end of the sleeve 12 that the flange 27 is formed. The member 19 and pivot pin 20 are similar to those shown and described with reference to Figure 3 (*b*). On assembly, the identical parts making up a complete inner metal element 11 and rubber sleeve 12 are inserted one part in each end of the member 19 with the flanged ends of the parts protruding from the member 19 and the reduced ends of the parts in abutment. The inner metal elements 11 are then radially expanded to compress the rubber and produce adherence between the rubber and the member 19 at the interface 28. Subsequently this assembly is passed over the bearing surface 23 of the pivot pin 20 and clamped between the flange 22 of the pin and the washer 25, as before. It will be seen that, upon this final assembly, the flanges 27 of the rubber sleeves 12 form buffers 26 frictionally engaging the ends of the members 19 and the confronting faces of the flange 22 and washer 25 on the pin 20.

The rear spring shackle bush shown in Figures 5 (*a*) and (*b*) is similar to that shown in Figures 3 (a) and (*b*) with the exception that a shackle pin 28 is shown instead of a pivot pin 20, and that the length of the rubber sleeve 12 equals that of the inner metal element 11. Conveniently, the ends of the sleeve 12 are tapered from the interface 13 to the outer surface of the sleeve as clearly shown in Figure 5 (*a*). On assembly buffers 26 are formed between end plates on the shackle pin 28 and the outer member 19 which, in this instance, is a spring eye.

The end buffers 26 shown in Figures 3 (*b*), 4 (*c*) and 5 (*b*) effectively prevent metal-to-metal contact between the flange 22 and washer 25 and the outer metal member 19. This feature is particularly desirable for the bushes of the rear springs of road vehicles.

In cases where large axial loads will be carried by a bushed element it may be desirable to provide a bush in the form shown in Figures 6 (*a*) and (*b*), in which a bonded cylindrical expansible inner metal element 11 and surrounding rubber sleeve 12 are employed as, for example, in the form shown in Figure 6 (*a*). The outer metal element 14 can be provided with one or a series of axially displaced circumferential depressions or grooves 29 around its inner periphery, the least diameter of the bore of the element 14 being such as to permit the bonded element 11 and sleeve 12 readily to be inserted in the bore. Upon assembly, as shown in Figure 6 (*b*), the inner element 11 is expanded at 30 to pre-compress the rubber sleeve 12 and force it to flow into the grooves 29 and adhere to the interface between the sleeve and the outer element 14. This expansion may, for instance, be effected with the aid of a hollow mandrel fitted with expansible collets adapted to be expanded by the passage of a taper drift through the mandrel. By inserting the mandrel within the element 11 and expanding the collets while the mandrel is rotated, the required grooves 29 can be formed.

If desired, the inner element 11 may be pre-expanded uniformly along the whole of its length before being expanded at the regions 30. It will be understood that the above embodiment provides only a single example of a ribbed bush. If desired, the sleeve 12 may be formed in two or more parts as in Figures 4 (*a*), (*b*) and (*c*).

Another use to which the improved bush may be put is in the hinges of the component portions of endless tracks such as are used on armoured vehicles or tanks or other endless track vehicles as illustrated in Figures 7 (*a*), (*b*), and (*c*). A cylindrical expansible inner metal element 11 is employed, provided with a single rubber sleeve 12, or, as in Figure 7 (*a*), with a series of bonded rubber sleeves 12, preferably one sleeve 12 for each lug 31 of the hinge joint. The bonded inner metal element 11 and sleeves 12 are fitted into cast holes in the hinge lugs 31 of the track components and the inner metal element is then radially expanded to compress the rubber and cause it to adhere to the surfaces of the cast holes. A drift for the expansion operation can be formed by the ordinary pivot pin 32 if this is provided with conical ends 33, as in Figure 7 (*b*). Alternatively, the pivot pin may be tubular, as indicated at 34 in Figure 7 (*c*) with internally screw-threaded ends 35 to receive set bolts (not shown) preventing axial displacement of the tubular hinge pin 34.

In couplings employing links between the two parts of the coupling the bush may conveniently be employed for the pivots of the links and, in this case also, the moulded units can be expanded directly into die cast links.

Obviously as is known in connection with hinge bushes the bush can be provided with ribs around its circumference which will lie outside the housing or eye and can serve as compressible flanges between the sides of the housing and any clamping means on the hinge.

In cases where it is desired to increase the axial stiffness and load capacity of bushed components the constructions illustrated in Figures 8 (*a*) or (*b*) may be employed. As

shown in Figure 8 (*a*) the bonded inner element 11 and sleeve 12, after insertion in an outer element 14 having the ends 36 of its inner bore outwardly flared, are radially expanded to pre-compress the rubber and are then outwardly flared at the ends, as indicated at 37 to provide a bell mouth at end end of the inner element 11 and compress the rubber between the ends 36 and 37 of the outer and inner metal elements respectively.

In the alternative form shown in Figure 8 (*b*) a liner 38 is interposed between the outer metal element 14 and the rubber sleeve 12. This construction is achieved by inserting an assembled liner 38 and bonded inner element 11 and rubber sleeve 12 in the outer element 14, pre-compressing the rubber by expanding the inner sleeve 11, and then outwardly flaring the ends 37 of the inner element 11 to compress the rubber between these flared ends 37 and similarly flared ends of the liner 38.

Figures 9 (*a*) and (*b*) illustrate alternative outer metal elements, adaptors or housings 14 adapted each to receive a bonded cylindrical expansible inner metal element 11 and rubber sleeve 12, which element 11 is subsequently expanded to pre-compress the rubber and cause it to adhere to the inner wall of the element 14. Figures 9 (*c*), (*d*) and (*e*) illustrate alternative outer elements 14 in the form of bearing eyes adapted to receive a bonded cylindrical expansible inner metal element 11 and rubber sleeve 12, which element 11 is expanded to pre-compress the rubber and cause it to adhere to the inner wall of a tubular liner 38 inserted in or co-acting with the bore or inner surface of the eye. Figure 9 (*f*) differs from the above in that a split or clamp-like outer metal element 14 is employed. In this case the inner element 11 may be expanded after it has been clamped, with its bonded sleeve 12 in the element 14.

The word "rubber" used in this specification is intended to include any suitable rubber whether produced from natural rubber or a suitable synthetic rubber.

The instances given above of the application of the bush are given as examples only and not as limiting its range of application.

We are aware that in the published abridgement of Specification 348,327 it is stated that a liner between an inner metal bearing member and a deformable sleeve of a bush is of harder material having a "high co-efficient of friction such as brass or impregnated woven fabric"; but no disclosure of brass as a material suitable for the inventor's purpose appears in the published Specification 348,327.

What we claim is:—

1. A bush comprising an expansible continuous hollow cylindrical metal element and a cylindrical rubber sleeve moulded around the element and surface bonded thereto, the unbonded surface of the rubber sleeve being free.

2. A bush as claimed in Claim 1 in which at least one end of the rubber sleeve overhangs the adjacent end of the inner metal element.

3. A bush as claimed in Claim 1 or Claim 2 in which at least one end of the rubber sleeve has an outwardly directed radial flange.

4. A bush as claimed in Claim 1 in which at least one end of the inner metal element extends beyond the adjacent end of the rubber bush.

5. A bush as claimed in any of the preceding claims in which the rubber sleeve is formed in two or more sections.

6. The method of bushing with rubber metal elements adapted to be assembled one wholly or partly within the other comprising slidably or otherwise inserting a bush as claimed in any of the preceding claims into a suitable bore in an outer metal element, and outwardly expanding the expansible inner metal element to pre-compress the rubber sleeve in all radial directions and produce adherence of the outer surface of the rubber sleeve with the surface of the bore of the outer metal element.

7. The method of bushing metal elements as claimed in Claim 6 in which an overhanging or flanged end of the rubber sleeve is compressed between confronting faces of an end of the outer metal element and a metal member entered into abutment with that end of the inner metal element adjacent the overhanging or flanged end of the bush.

8. The method of bushing metal elements as claimed in Claim 6 in which, after assembly in the outer metal element the ends of the inner metal element are flared outwardly towards similarly flared ends of the bore of the outer metal element, whereby the ends of the rubber sleeve are preloaded in compression between the flared ends of the inner and outer metal elements.

9. A bush substantially as hereinbefore described and as illustrated with reference to Figure 1 (*a*), 2 (*a*), 3 (*a*), 4 (*a*), 4 (*b*), 5 (*a*), 6 (*a*) or 7 (*a*) of the accompanying drawings.

10. A bush assembly made in accordance with any of the preceding Claims 6, 7 or 8 substantially as hereinbefore described and as illustrated with reference to Figures 1 (*c*), 2 (*c*), 3 (*b*), 4 (*c*), 5 (*b*), 6 (*b*), 7 (*b*), 7 (*c*), 8 (*a*), 8 (*b*), 9 (*a*), 9 (*b*), 9 (*c*), 9 (*d*), 9 (*e*) or 9 (*f*) of the accompanying drawings.

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75 & 77, Colmore Row, Birmingham 3.

PROVISIONAL SPECIFICATION

Bonded Rubber Bushes

We, METALASTIK LIMITED, a British Company, of Evington Valley Road, Leicester, do hereby declare this invention to be described in the following statement:—

This invention relates to bonded rubber bushes comprising a metal sleeve and a surrounding elastic material. Rubber bushes are known in which an inner tubular metal member and an outer tubular metal member are employed with the elastic material arranged as a filling in the space between them, the surfaces of the filling being secured to the opposing metal faces of the tubular metal members. In Patent Specification 581,164 a rubber filling is surface-bonded by vulcanisation to the opposing surfaces of the metal members and, after the bonding, the filling is placed under compression by the distortion of one of the metal members in a manner causing reduction of the space between them throughout the length of the bush. The compression thus applied replaces the state of tension normally liable to be present in the rubber after vulcanization and leaves a condition of pre-compression therein.

It is also known to employ a rubber bush around an inner metal member the bushing being forced under axial pressure into housings, as for example into the hinge eye of a vehicle spring. The forcing of the bush into place causes such adhesion of the rubber surface to the housing as to enable the rubber to function as a torsion spring between the housing and the inner metal member permitting, with resistance in torsional shear, a degree of pivotal or angular movement between the housing and the inner metal member and resisting, mainly in compression, relative radial movements between the inner metal member and the housing.

The present invention comprises a rubber sleeve surface-bonded to an inner metal member and made to adhere to a housing by the forcible expansion of the inner metal member or by contracting the outer metal member or housing on to the rubber.

In the former case the metal inner member is tubular and the rubber is moulded around it and bonded by vulcanisation to the outer metal surface. The rubber is of the size to permit the compound metal and rubber bush to be a sliding fit in the housing and, after it is placed therein, the tubular metal inner member is expanded by forcing a drift with a taper end through it, or by other suitable method, so that the rubber between the outer surface of the metal tube and the inner surface of the housing is in a state of compression.

If a contractable outer metal member is provided the inner metal member can be a tube or it may be a solid member such as a pivot pin. The rubber is bonded thereon and a contractable metal sleeve is fitted around it and contracted by forcing the complete bush through a die with a bell mouth or equivalent lead, or by other suitable method, by which operation the rubber is preloaded in compression.

The bushes made as set forth may be used for many purposes and offer advantages in economy and ease of manufacture, and some saving in space where they are fitted direct into a housing. The housings do not require such accurate finishing and cast bores or rolled spring eyes can be satisfactorily bushed.

If the improved bush is intended for use as a spring shackle bush, it can be supplied either without an outer sleeve of metal or with an outer sleeve in which case the latter will be contracted on to the rubber. The rubber may be arranged to extend beyond the housing and the inner metal member at each end of the bush so that when the clamping means is applied to the bush, which is within the housing, pressure is applied to the extended rubber end to load the rubber filling of the bush additionally in compression. This is of advantage where large axial loads have to be carried with a minimum of deflection of the bush.

Another use to which the improved bush may be put is in the hinges of the component portions of endless tracks such as are used on armoured vehicles or tanks and on other endless track vehicles. The bush without an outer metal sleeve can be fitted into cast holes in the hinge lugs of the track components and the inner tubular metal member can be expanded as before set forth. A drift for the expansion can be formed by the ordinary pivot pin, if this is provided with conical ends. A single moulded bush can be used for track hinges in which there are a plurality of hinge lugs or the joint can be made up using separate bushes for each hinge lug.

In couplings employing links between the two parts of the coupling the bush may conveniently be employed for the pivots of the links and in this case also the moulded units can be expanded directly into die cast links.

Obviously as is known in connection with hinge bushes the bush can be provided with ribs around its circumference which will lie outside the housing or eye and can serve as compressible flanges between the sides of the housing and any clamping means on the hinge.

The word "rubber" used in this specification is intended to include any suitable rub-

ber whether produced from natural rubber or a suitable synthetic rubber.

The instances given above of the application of the bush are given as examples only and not as limiting its range of applicati

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